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EXAMINER	
MURPHY, DANIEL L	

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3663	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/604,878	ESMERSOY ET AL.	
	Examiner	Art Unit	
	DANIEL L. MURPHY	3663	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 23 August 2010.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 36-43 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 36-43 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on 22 August 2003 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on August 23, 2010 has been entered.

Response to Arguments

2. Applicant’s arguments have been fully considered but they are not persuasive. Applicant’s items will be taken in turn.

3. Regarding Applicant’s item 1, the examiner notes that Applicant does not dispute that Kan discloses the first three elements of claim 36. Therefore only the fourth element need be discussed in this section. The fourth element recites

> inverting the surface seismic data obtained using the plurality of surface-located seismic sources and receivers to determine a velocity ahead of the drill bit while constraining velocity between the surface and the drill bit to be consistent with the velocity determined from the travel time.

The Applicant claims that the fourth element of claim 36 is not mentioned or implied in any part of Kan.

4. As previously discussed, Kan discloses inverting reflection seismic data (data reflected from structures below the drill bit and received in the borehole receivers), although not specifically the surface seismic data, to determine a velocity ahead of the drill bit while constraining the velocity between the surface and the drill bit to be consistent with the velocity determined from the travel time (Column 6, Lines 20-37; Column 8, Line 40 to Column 9, line 3).

5. Kan at column 6, lines 20-37 recites (emphasis added):

(f) Perform a seismic survey in area of interest so as to determine velocity as a function of depth for a line or a grid of surface locations with separations of about a few hundred feet. Acquisition, processing and interpretation of reflection seismic data follows well known methods. **Briefly, the Common Midpoint (CMP) method at each line or grid point provides multiple measurements of distance from seismic surface source to surface receiver and wave reflection time for any given subsurface reflecting interface or "reflector"; see FIG.7*a*.** Seismic response to a given reflector in a CMP gather can be approximated by a hyperbola: the square of transit time from source to receiver depends upon the square of distance between source and receiver divided by the square of a velocity (the stacking velocity); see FIG.7*b*.

In the emphasized sentence above, “any given subsurface reflecting interface” includes those ahead of the drill bit.

6. Kan at column 8, line 40 to column 9, line 3 recites (emphasis added):

> The primary applications of VSP are correlating time-to-depth, **calibrating seismic interval velocity data, and integrating surface seismic with borehole data**. When **VSP data are used to calibrate interval velocities obtained from surface seismic data**, predictions of depths and magnitudes of geopressure from surface seismic can be more accurate. Thus, in step (f) of the first preferred embodiment, computed interval transit times for already-drilled portions of the well are replaced using VSP- or check shot-corrected velocity; this typically changes total transit time to the already drilled depth and thereby shifts computed interval transit times below already-drilled depth; see FIGS. ll*a*-*b*. Then step (g) of the first embodiment can be performed to obtain a check shot-corrected pressure gradient prediction. FIG. ll*c* shows an updated pressure predicted using the updated interval transit time.
>
> The VSP receiver will also record waves from the surface source that have been reflected from structures beneath current well bottom; **this amounts to a seismic survey below bottom of the well**. In fact, the VSP receiver first records the direct downgoing wave from a surface source shot and then records upgoing reflections of this same wave from structures below well bottom, so reflected wave times and amplitudes are recorded along with direct arrival data. **Then, using inversion methods (a single receiver implies no CMP), times and amplitudes can be converted to interval velocity data. Results are calibrated using VSP data from depths which overlap a zone of the well which has already been logged with a seismic tool.**

The emphasized phrases above, “calibrating seismic interval velocity data, and integrating surface seismic with borehole data,” and “VSP data are used to calibrate

interval velocities obtained from surface seismic data," show that Kan discloses constraining velocity between the surface and the drill bit to be consistent with the velocity determined from the travel time. Calibration of seismic interval velocity data is nothing more than imposition of constraints that interval velocities determined via the surface seismic survey must agree with (that is, be consistent with) interval velocities measured with VSP.

7. Kan goes on to discuss that the VSP receiver records upgoing reflections as well: "this amounts to a seismic survey below the well" (col. 8, lines 60-61). From the upgoing reflections received during VSP, interval velocity data are obtained using inversion methods. These interval velocity data supplement the surface seismic interval velocity data – already constrained as described above to be consistent with the velocity determined from the (VSP) travel time. Moreover, Kan also calibrates (i.e., constrains) the VSP obtained interval velocity data below the drill bit "using VSP data from depths which overlap a zone of the well which has already been logged with a seismic tool" (col. 9, lines 1-3). The entire set of seismic survey data – the surface seismic survey data above the drill bit, the surface seismic survey data below the drill bit, and the VSP seismic survey data below the drill bit – is constrained by the calibration of the surface seismic survey data above the drill bit with the VSP-determined velocities above the drill bit.

Kan thus discloses the fourth element of claim 36, as previously discussed in earlier Office actions.

8. Regarding Applicant's item 2A, Kan's constraining of velocities has been discussed above. It is worth pointing out with regard to Applicant's item 2B that Kan does describe both collection and conventional processing of surface seismic data (col. 6, lines 20-36), and processing and inversion of seismic data following VSP data collection (col. 8, line 40 to col. 9, line 3), as discussed above.

9. Applicant's assertions as to what the application discloses and/or fully enables are irrelevant to the issue of whether Kan discloses the fourth element of claim 36. Moreover, Applicant's discussion of Figure 1 included with the communication of August 23, 2010 contradicts what Kan clearly states in the patent. As one example, Kan states, "[t]hus, in step (f) of the first preferred embodiment, computed interval transit times for already-drilled portions of the well are replaced using VSP- or checkshot-corrected velocity" (col. 8, lines 47-50). It is difficult to reconcile the cited excerpt from col. 8, lines 47-50, along with the other cited portions of Kan discussed above, with Applicant's assertion toward the end of item 2B that the "constrained" inversion of claim 36, "is not applicable to VSP inversion and therefor not discussed by Kan."

10. Regarding Applicant's item 3, it is not necessary for Kan to use the actual word "constrain" in order to disclose the fourth element of claim 36. Kan discloses the VSP or

checkshot data are used to determine velocities, which are then used to calibrate seismic interval velocity data. As discussed above, calibration of seismic interval velocity data is nothing more than imposition of constraints that interval velocities determined via the surface seismic survey must agree with (that is, be consistent with) interval velocities measured with VSP. This is true as much for below-bit seismic velocity data as it is for above-bit seismic velocity data.

11. Regarding Applicant's item 4, the examiner notes that Applicant does not dispute the examiner's previous comments:

"Kan discloses surface seismic data and discloses a plurality of surface located source and receiver locations used to take the surface seismic data as common midpoint data (Column 6) (Fig. 7a), but does not specifically disclose that a plurality of surface located sources and a plurality of surface located receivers are used to obtain the surface seismic data. Ireson teaches that it is known that surface seismic data are obtained using a plurality of surface sources and a plurality of surface receivers are used in obtaining surface seismic data (Fig. 1) (Column 1, Lines 9-40). It would have been obvious to use a plurality of sources and receivers to obtain the surface seismic data in Kan as taught by Ireson in order to obtain common midpoint data about an origin or midpoint."

The Applicant goes on to assert that the excerpt above does not mention constraining the inversion of surface seismic ahead of the drill bit using the surface to bit measured travel times. Kan does disclose "inverting the surface seismic data obtained using the plurality of surface-located seismic sources and receivers to determine a velocity ahead of the drill bit while constraining velocity between the surface and the drill bit to be consistent with the velocity determined from the travel time" as discussed above. Applicant quotes a particular, single paragraph of the previous Office action to bolster Applicant's claim that the Kan reference nowhere discloses the fourth element of claim 36. The lack of a particular detail in a single paragraph does not show Kan is deficient in disclosing the fourth element of claim 36. The Kan patent as a whole must be considered.

12. Regarding Applicant's item 5, the examiner points out that the rejection of claim 36 is based on 35 USC § 103(a). Kan need not teach all of the fourth element of claim 36. It suffices that the subject matter as a whole would have been obvious to one having ordinary skill in that art at the time the invention was made. Kan in combination with Ireson and Stewart satisfies the requirements of 35 USC § 103(a). As the examiner stated in the previous Office action, page 7:

"[Kan] does not specifically disclose that the velocity determined from the surface seismic data is determined by an inversion of the surface seismic data. Stewart teaches that inversion methods are used on both VSP and surface data when

determined velocity structures of underground formations (Page 358, Summary; Page 359, Second Column to Page 360 Second Column). It would have been obvious to use an inversion process on the surface seismic data in Kan to determine the velocity structure as taught by Stewart in order to determine the velocity structure of the subsurface in depth."

13. Regarding Applicant's item 6, Applicant appears to be mischaracterizing Kan. In brief, Kan discloses a method having steps (a) through (g). In step (a), well log data is used to determine shale fractions vs. depth in a subsurface formation. In step (b) the shale fraction vs. depth data is examined, and 10-foot vertical depth thicknesses are identified where the shale fraction is at least 90%. For these identified intervals, compressional wave sonic velocities are obtained with a sonic logging tool. Thus, at identified intervals from the surface down to the bottom of the well, interval transit times are known as well as the depths at which those interval transit times are determined. There is no need to recalculate these depths, or carry out "depth shifting;" the depths are known by direct measurement.

14. Steps (c), (d), and (e) concern generating the pressure translation curve used in Kan's method, and have no bearing on Applicant's item 6.

15. In step (f), as discussed above in paragraph 5, a surface seismic survey is performed. The results of the surface seismic survey provide the velocity profile for the

remainder of the subsurface, that is, for depths outside of the identified intervals at which the sonic logging was done in (b). The seismic velocity profile allows for determination of interval transit times for those intervals not identified in step (b).

16. In step (g), the departure of the interval transit times determined in (f) from the compaction trend line (derived in step (d) as part of generating the pressure translation curve) is calculated, then the pressure translation curve determined on the basis of steps (c)-(e) is employed to convert the interval transit time departure data into pore pressure gradients.

17. What VSP adds to this is calibration of the velocities that were not measured with the sonic logging tool (i.e., not associated with an identified interval in (b)), but were instead measured in the surface seismic survey. There is no “depth shifting” involved, as the depths are known. Kan’s disclosure, “[t]hus, in step (f) of the first preferred embodiment, computed interval transit times for already-drilled portions of the well are replaced using VSP- or check shot-corrected velocity; this typically changes total transit time to the already drilled depth and thereby shifts computed interval transit times below already-drilled depth; see FIGS. ll*a-b*” (col. 8, lines 47-53) refers to shifting the interval transit time. It does not refer to shifting depth associated with the interval transit time. Moreover, Fig. 11*a*, which shows a plot of inverse velocity against depth, does **not** show that the check shot adjusted interval transit time data is simply a shift in depth of the original seismically derived interval transit time data, particularly, for depths below

the bottom of the well. It is clear that the check shot adjustment has brought about redetermination of the original seismically derived interval transit time data, and Kan has explained in col. 8, line 40 to col. 9, line 3, that this has been brought about through "constraining velocity between the surface and the drill bit to be consistent with the velocity determined from the travel time" to use the language of the fourth element of claim 36.

18. Regarding Applicant's item 7, there appear to be a number of errors. One is Applicant's assertion that in Kan, only VSP data is used. Kan clearly states "[p]erform a seismic survey …for a line or a grid of surface locations … [T]he Common Midpoint method at each line or grid point provides multiple measurements of distance from seismic surface source to surface receiver." (col. 6, lines 20-28). Another is Applicant's assertion that VSP data are used in Kan for the purpose of depth shifting seismic events. As discussed in connection with Applicant's item 6, above, there is no "depth shifting," as described by Applicant, performed or disclosed in Kan. Yet another error is Applicant's assertion that Stewart does not use an inversion process on surface seismic data in order to determine the velocity structure of the subsurface in depth. This assertion by Applicant is not true. Stewart teaches:

"Tomographic analysis [traveltime inversion] is used to determine a seismic velocity structure in depth. A ray tracing example for selected sources and receivers is shown in

Fig. 2. The resultant velocity structure in depth is plotted in Fig. 3" (Page 359, col. 2, third paragraph).

19. Applicant asserts "[t]here is no inversion of surface acquired seismic, particular (sic) at greater than bit depths constrained by VSP information described in Stewart." It is irrelevant whether Stewart shows inversion of surface acquired seismic data at greater than bit depths constrained by VSP information, since this is shown by Kan.

Claim Rejections - 35 USC § 103

20. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

21. Claims 36-39, and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kan in view of Ireson (6201765) and Stewart (ASEG/SEG Conference - Adelaide, 1988).

22. With regard to claim 36, Kan discloses a method of estimating velocity ahead of a drill bit disposed in a subsurface region (Column 8, Line 40 to Column 9, Line 10). Kan discloses obtaining surface seismic data for a region of interest (Column 6, Lines 20-37; Column 8, Lines 40-57). Kan discloses during drilling of a borehole traversing

the subsurface region, determining a travel time of a seismic wave generated from a surface of the region to a location in the borehole when the drill bit is at selected depths in the borehole (Column 7, Line 66 to Column 8, Line 57). Kan discloses determining a velocity from the travel time and the selected depths (Column 8, Lines 1-57). Kan discloses inverting reflection seismic data (data reflected from structures below drillbit and received in the borehole receivers), although not specifically the surface seismic data, to determine a velocity ahead of the drill bit while constraining the velocity between the surface and the drill bit to be consistent with the velocity determined from the travel time (Column 6, Lines 20-37; Column 8, Line 40 to Column 9, line 3). Kan discloses that the VSP data is used to replace interval transit times from the surface seismic data with the velocity determined from the VSP checkshot survey to the depths of the borehole that the VSP data was taken. Replacing the velocity constrains it to being the velocity determined from the transit times of the VSP survey in the borehole.

23. Kan discloses surface seismic data and discloses a plurality of surface located source and receiver locations used to take the surface seismic data as common midpoint data (Column 6) (Fig. 7a), but does not specifically disclose that a plurality of surface located sources and a plurality of surface located receivers are used to obtain the surface seismic data. Ireson teaches that it is known that surface seismic data are obtained using a plurality of surface sources and a plurality of surface receivers are used in obtaining surface seismic data (Fig. 1) (Column 1, Lines 9-40). It would have been obvious to use a plurality of sources and receivers to obtain the surface seismic

data in Kan as taught by Ireson in order to obtain common midpoint data about an origin or midpoint.

24. Although Kan does not teach inverting the surface seismic data, Kan does disclose finding the velocities above the drill bit with the VSP, and then using this data in the process of finding interval velocities ahead of the bit by inversion methods for seismic data that has been reflected from structures ahead of the bit and received at receivers in the wellbore (Column 6, Lines 20-37; Column 8, Line 40 to Column 9, line 3). Kan teaches that the velocity determined from the surface seismic data is constrained by the velocity determined from the travel times and depths of the waves from the surface to the borehole location (Column 6, Lines 20-37; Column 8, Line 40 to Column 9, line 3), but does not specifically disclose that the velocity determined from the surface seismic data is determined by an inversion of the surface seismic data. Stewart teaches that inversion methods are used on both VSP and surface seismic data when determined velocity structures of underground formations (Page 358, Summary; Page 359, Second Column to Page 360 Second Column). It would have been obvious to use an inversion process on the surface seismic data in Kan to determine the velocity structure as taught by Stewart in order to determine the velocity structure of the subsurface in depth.

25. With regard to claim 37, Kan discloses transforming the velocity ahead of the drill bit into pore pressure of a region ahead of the drill bit (Column 6, Line 20 to Column 7, Line 21 ; Column 8, Lines 5-57).

26. With regard to claim 38, Kan discloses that the seismic wave is generated by a seismic source positioned near an opening of the borehole (Column 8, Lines 1-18).

27. With regard to claim 39, Kan discloses that determining the travel time of the seismic wave comprises detecting the seismic wave from at least one seismic receiver at location in the borehole (Column 8).

28. With regard to claim 41, Kan discloses that determining the travel time further comprises measuring the arrival time of the seismic wave detected at the seismic receiver and determining the travel time from the arrival time (Column 8, Lines 10-57).

29. Claims 40 and 42-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kan in view of Ireson (6201765) and Stewart (ASEG/SEG Conference - Adelaide, 1988) as applied to claims 36-39 and 41 above, and further in view of Eaton (6382332).

30. With regard to claim 40, Kan does not disclose that the seismic receiver is disposed in a downhole tool near the drill bit. Kan discloses using the receiver during drilling, but does not disclose the location of the receivers used. Eaton teaches a

method of determining time-depth check-shots and also obtaining VSP data using a downhole tool 14 that is located near the drill bit 13 (Fig. 1) (abstract; Column 2). It would have been obvious to modify Kan to include using a tool located near the drill bit for the receiver in the borehole in order to be able to take data without requiring that the drillstring be removed or that further devices are placed into the borehole.

31. With regard to claim 42, Kan does not disclose that measuring the arrival time comprises sending the seismic wave detected in the borehole to the surface and processing the detected seismic waves at the surface to determine arrival time. Kan does not disclose where the processing is performed. Eaton teaches that data obtained in receivers in a borehole can be sent to the surface for processing (Column 6, Lines 18-46). It would have been obvious to modify Kan to include sending the data to the surface to be processed as taught by Eaton in order to have a central processing unit at the surface that can perform all of the necessary data processing and also control the survey apparatus.

32. With regard to claim 43, Kan does not disclose that measuring the arrival time comprises processing the seismic wave detected in the borehole to determine the arrival time and sending the arrival time to the surface via telemetry. Kan does not disclose where the processing is performed. Eaton teaches that the data received in a borehole receiver can be processed in the receiver (Column 5, Lines 55-65; Column 6). It would have been obvious to modify Kan to include performing the processing in the

borehole and sending the time to the surface via telemetry as taught by Eaton in order to reduce the data rate to a level commensurate with the link to the surface and to limit the amount of data that needs to be transmitted to the surface.

Conclusion

All claims are drawn to the same invention claimed in the application prior to the entry of the submission under 37 CFR 1.114 and could have been finally rejected on the grounds and art of record in the next Office action if they had been entered in the application prior to entry under 37 CFR 1.114. Accordingly, **THIS ACTION IS MADE FINAL** even though it is a first action after the filing of a request for continued examination and the submission under 37 CFR 1.114. See MPEP § 706.07(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DANIEL L. MURPHY whose telephone number is (571)270-3194. The examiner can normally be reached on Monday through Friday, 8:30 am to 5:00 pm Eastern Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack Keith can be reached on 571-272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/D. L. M./
Examiner, Art Unit 3663

/JACK KEITH/

Supervisory Patent Examiner, Art Unit 3663